in a "black horny riband, bearing at its extremity a spatulate web" (Wallace). Why have the females of *Parotia sexpennis* no spatulate occipital plumes, and those of the spatulate or bare rachised tailed Birds of Paradise no rackets, if the character is a non-sexual one? In the case of the Motmots, may not the narrowing of the web of the tail feathers be due to some physiological, pathological, or other cause, which attracts the bird's notice to the spot, causing it to peck at the feather and eventually bite away its webs; a habit which might become as fixed as the biting of the nails is from parent to children in many families. In the specimens which lived in the Zoological Gardens in London the central tail feathers came in with the webs on and were bitten off by the birds. The spatulate feathers would not arise, or would be lost, probably, if the Motmots left their tails alone. The very varied positions in which these singular plumes appear (altogether only in a few groups of birds), seem to indicate that it is not a question of attrition or excitation on objects with which the feathers come in contact, otherwise the occurrence of similar feathers would be far more common than it is, especially in the families to which the birds sporting such ornaments belong, since their habits, flight, and movements are similar. And if the rush of air through the feathers of the wing of certain pigeons can produce attenuation of their first primary, the same, or at least some, effect ought to be produced by the same cause, not only in many other pigeons, but also in hosts of other birds.

The final section of the introduction discusses the geographical distribution of the birds of the Celebesian area, and shows that it is inhabited by 393 species, and that fifteen genera and 108 species are peculiar to it. Each species is fully treated of in the systematic part of the work, as to its synonymy and diagnosis, with interesting and often lengthy accounts of its distribution and habits. Of these, seventy-seven are figured in forty-five plates by Herr Geisler, the artist of the Dresden Museum, who has, at the request of the authors, represented "the exact hue of the specimens painted, sometimes at the cost of the artistic effect and clearness of tint seen in the English productions." The work is also embellished by seven maps—two climatological, two topographical, and three devoted to geographical distribution.

As a result of their laborious investigations, the authors find that

"one-half of the peculiar birds of Celebes have their nearest affinities in the Oriental Region, and one-fifth only in the Australian Region; but the Australian forms seem to be, on the average, rather more strongly differentiated than the Oriental forms. . . . The origin of the Celebesian avi-fauna is principally an Asiatic one, but Celebes, as a whole or as a group of islands, was separated early from the Continent, or never was intimately connected with it. . . . The special faunas of Celebes, however, . . . are far from worked out. . . . The future, therefore, only can decide whether the ornithological facts as at present known teach us correctly that Celebes belongs to the Oriental Region and not to the Australian . . ."

The authors are to be congratulated upon the production of one of the best and most exhaustive ornithological monographs of a special region that have for a long time appeared either in England or on the Continent.

PUMPING IN MINES.

Mine Drainage; being a Complete Practical Treatise on Direct-Acting Underground Steam Pumping Machinery. By Stephen Michell. Second edition. Pp. xviii + 369. (London: Crosby Lockwood and Son, 1899.)

AS a somewhat heterogeneous collection of statistics, drawings and descriptions of pumping machinery, the work before us probably stands unrivalled in our own or any other language. It is profusely illustrated by means of excellent phototypes and woodcuts of pumping engines, as well as the details of their valves and valve gear, and contains minute verbal descriptions of their construction and mode of action. According to the author, most of the drawings have been supplied by the engine-makers, a fact with which no fault can be found, since there is no better source from which illustrations for a work like this can be obtained. But when we come to a consideration of the verbal descriptions the matter assumes a different aspect. Except in those cases in which an author feels himself bound to explain the views or original work of another author with precision, so as to avoid the possibility of misconstruction, descriptions quoted verbatim are out of place. In describing appliances with which he is, or ought to be, familiar, he should do so in his own words and from his own point of view, and at the same time give the reader the benefit of his opinions and criticism. If he quotes page after page from trade catalogues as our author does, not omitting even letters of commendation from customers, he abdicates his claim to the position of an author and becomes a simple compiler.

The work before us partakes far too much of this character, being to a large extent a compilation of the contents of catalogues; and as this is a class of information that is liable to vary with the issue of each new catalogue, and can be always obtained post free, it is a pity to swell the bulk of a volume by inserting it without measure.

The first twenty-two pages of the book contain introductory matter, including a few definitions and a history of the Worthington and other pumps; then follow four pages filled with the names of pumps and their makers, and thereafter the subject-matter is proceeded with. Hydraulic and electric pumps, together with four and a half pages of "Hydraulic and other memoranda," are, for no apparent reason, relegated to an appendix; and the volume closes with a good index.

In linking up the subjects and in venturing to express his own opinions, the author is not always equally happy in his remarks. For instance:—

"Height is essential to effectiveness in an air-vessel, mere lateral extension of volume adding little to its value" (p. 72)

"The pump valves act a most important part in the action of the pump. Indeed, their function is a most important one, and they may fitly be described as the 'lungs' of the pump" (p. 82).

"A speed of 100 feet per minute is quite sufficient for small steam pumps if an excessive resistance in the rising main is to be avoided" (p. 94).

Apart from the resistance due to the head, which is the same whether the pump is large or small, a pump

encounters no other resistance in the *rising main* or discharge pipe, except that due to the friction of the ascending water. The amount of that resistance is a function of the velocity of flow, the area in cross-section, and the length of the discharge pipe, and is in no other way related to the size of the pump.

"The Kaselowsky system is similar to that of Messrs. West and Darlington, originated many years ago, and developed in the last dozen years in the Scotch collieries by Mr. Moore. The chief features in which it differs therefrom are the use of accumulator pressure and a very long stroke, admitting of considerable reduction in the dimensions of the underground engine" (p. 340).

Just before summing up in this way, our author has filled two and a half pages with a description of Kaselowsky's system, furnished by the Berliner Maschinenbau Actien-Gesellshaft, which he says "may be comprehensible."

Moore and Kaselowsky both transmit power by means of a forcing pump actuated by steam at the surface through two pipes filled with water to a pumping engine situate at the point in the mine from which water is to be raised. In Moore's pump, the water in each pipe moves first in one direction, and then in the opposite direction, acting the part of a rigid rod in its downward stroke, and the pumping engine in the mine oscillates in exact synchrony with the water in the pipes and with the forcing pump at the surface. Thus, if there were no leakage of motor water, each pipe would always remain filled with the same water that was originally put into it. Neither the forcing pump at the surface nor the pumping engine in the mine requires to have any distributing valves. The principal objection to this pump is that the pipes being subject to variations of pressure, expand and contract alternately, so that part of the stroke of the forcing pump, and consequently part of the work expended in driving it, is lost.

In Kaselowsky's pump, on the other hand, the motor water flows in a closed circuit, descending in one of the pipes and ascending in the other. The excess of pressure in the former over that in the latter is created by the forcing pump on the surface, and is expended in working the pumping engine in the mine. Both the forcing pump and the pumping engine are necessarily provided with distributing valves.

The pumping engine in the mine consists of two complete engines and pumps fixed side by side on the same bed plate, each of which actuates the distributing valves of the other in exactly the same way as this is done in a Worthington pumping engine. The accumulators to which our author refers are three in number. Their purpose is to prevent the occurrence of shocks in the motor water when the distributing valves open and close. The motor water, travelling from the forcing pump towards the pumping engine, passes under the plunger of the first accumulator just after it leaves the forcing pump at the surface, under that of the second just before it enters the distributing valve chest of the pumping engine in the mine, and under that of the third just after it leaves the same valve chest. They act exactly the same part towards the motor water as an air-vessel does towards the water discharged by a pump.

The difference between Moore's pump and Kaselowsky's is therefore a very wide one, and does not consist in "the use of accumulator pressure and a very long stroke," as we are so confidently informed.

In the hydraulic and other memoranda we find:

"Dia. of circle or cylinder + 7854 = area."

This must certainly be an oversight.

The rules for finding quantities are very arbitrary, as the two following examples will show, and no explanation is offered as to how they have been concocted.

Thus:—

"Square of dia. in feet × five times the depth in feet = gallons."

"Square of dia. in inches = lbs. of water for 3 feet long ÷ 10 = gallons."

Although the book is called "A Complete Practical Treatise," there seems to be no good reason why the hydraulic and other memoranda should have been pitched upon such a low level as to appeal only to the capacity of those who can do little more than read or write. The School Boards and the Science and Art Department now Board of Education, have for a number of years past been training many boys and men who are destined to irresistibly supplant the rule-of-thumb class for whom such rules were originally framed. The least of these would scorn to have a set of hard and fast rules thrust upon him without some kind of explanation, and no writer of the present day can afford to ignore this fact if he expects his work to be appreciated and to have a permanent value.

Mr. Michell's book is altogether too voluminous. In the first paragraph of his preface he strikes the key-note that should have been his guide in writing it, namely:—"Many of the engines in use when the work was first published have, in the severe ordeal of underground work, maintained their position as useful and effective pumping agents; others have failed, and are now only a name in the chronicle of mine pumps."

Thus, judging by the past, we may be quite sure that many more of those now in use will likewise disappear from the scene. If, instead of describing as many pumps now in use as he could find space for, our author had instituted careful inquiries to find out the most economical and trustworthy amongst them, if he had confined his attention solely to these, condensed his book to about one-quarter of its present size, and embodied a few leading formulæ in their proper places in the text for the use of the student and the educated man who is now, and is also yet to come, he would have produced a more interesting, readable and useful work than the one now before us.

We differ entirely from the views expressed by him to the effect that "In collieries with plenty of refuse coal and slack of no commercial value, much of it, perhaps, worth only a shilling or two per ton, a small initial outlay rather than economy in working, and a plant that occupies little space in the pit . . ." can ever be a consideration of such great importance in the eyes of a properly educated colliery manager as to determine him to adopt an uneconomical pump because of its cheapness in first cost. Such a man would foresee that additional boiler-power and additional labour for stoking the boilers would be required to supply steam to the wasteful pump.

He would therefore spend an additional sum on the pump itself rather than on the purchase of boilers and in stoking, and he might even be sufficiently far-seeing to capitalise the value of the coal he would save, and spend part of that amount also upon the pump.

In conclusion, the opinions expressed by our author to the effect that a pump placed in a chamber underground is for that reason necessarily neglected, and subjected to rough and unskilful treatment, that it cannot be so economical as an engine working on the surface, that steam pipes in the shaft heat the workings, and so on, all tend to betray a want of knowledge of the practice of educated and observant engineers and managers of the present day. They sound rather like an echo from the uninstructed past, or a dirge of the days that are now passing rapidly away. W. GALLOWAY.

THE PALAEONTOLOGY OF THE INVERTEBRATA.

Text-Book of Palaeontology. By Karl A. von Zittel. Translated and edited by Charles R. Eastman, Ph.D. Vol. i. Pp. viii+706; with 1476 woodcuts. (London: Macmillan and Co., Ltd., 1900.)

ENGLISH-SPEAKING geologists and palæontologists have awaited with eagerness the long promised translation of Prof. K. A. von Zittel's well-known "Grundzüge der Palaeontologie" which appeared early in 1895. At last we have received the first volume, which completes half the work, namely, to the end of the Invertebrata. It proves, however, to be much more than a translation of the German original. It is illustrated by the same beautiful woodcuts, with few additions; it is also similar in general plan; but most of the chapters have been entirely rearranged and rewritten, to express the views of the various American and English authors who have co-operated with Dr. Eastman. It is, therefore, virtually a new work, and the scheme of classification adopted is very different from that accepted by the eminent Professor of the University of Munich.

The only part of the "Grundzüge" which remains almost unchanged in the present translation comprises the admirable introductory chapter and the account of the sub-kingdoms Protozoa and Cœlenterata. Here the student will find Prof. von Zittel's own summary of his important researches on the structure and classification of the fossil sponges, which it is well to have left untouched. Changes begin with the Echinodermata, and attain their maximum in the Cephalopod Mollusca, becoming less noteworthy again in the Arthropoda, which conclude the volume.

Of the Echinodermata, the Crinoidea and Blastoidea were revised by the late Charles Wachsmuth. He added much new matter, and described and classified the crinoids in accordance with Wachsmuth and Springer's "Monograph on the Crinoidea Camerata of North America," which is here said to be "as yet unpublished," but really appeared in 1897. The sections on Asterozoa and Echinozoa have been extended, and in some respects much improved, by Mr. Percy Sladen, who has completely rearranged the Euechinoidea in accordance with the researches of the late Martin Duncan. The short description of the Vermes has been revised and slightly enlarged by Dr. G. J. Hinde. The chapter on Bryozoa is no longer that of Prof. von Zittel, but the work of Mr. E. O. Ulrich, who has added many new figures. It is not quite up to date, there being no references to Dr. Gregory's "British Museum Catalogue" or his memoir on early Tertiary Bryozoa, published by the Zoological Society. The Brachiopoda, revised and partly rewritten by Mr. Charles Schuchert, are arranged according to Beecher's classification, which is described in von Zittel's original as "one-sided," being based only on embryology. The rearrangement of the Mollusca has been undertaken by Messrs. Dall, Pilsbry and Hyatt, who deal respectively with the Pelecypoda, Gastropoda and Cephalopoda. Here it is difficult to recognise any of the original "Grundzüge" except the figures. In the description of the Arthropoda, Prof. Charles E. Beecher has added much important new matter to the section on Trilobita, which students will be glad to have. The treatment of the higher Crustacea and Merostomata is also much changed by the revision of Profs. Clarke and Kingsley; but the Arachnida, Myriopoda and Insecta, edited by Mr. Scudder, remain almost as in the original German work.

With so many collaborators, it has naturally been impossible for Dr. Eastman to obtain uniformity of style throughout the volume; and the judgment which teachers and original workers will pass upon it depends largely on the section which they happen to consult. On the whole, we are disposed to prefer the original volume in the form in which it was issued by the distinguished teacher who prepared it. With all due deference to the eminent specialists who have devoted so much labour to the translation and revision, we cannot refrain from expressing our opinion that they have converted an admirable student's manual into little more than an index to certain technical memoirs, which are as yet by no means accepted classics in palæontology. As Prof. von Zittel himself remarks in his preface, many of these memoirs are founded on certain embryological and phylogenetic considerations, which may soon prove to be baseless assumptions; while the old methods of comparative anatomy are often almost abandoned in favour of some one-sided hypothesis. We would also note that a large proportion of the generic names adopted are quite unknown in the original works on geology and palæontology which the average student will have to consult at the beginning of his career. In short, if the translators and revisers had devoted more attention to the correction of errors or the incorporation of new facts, and displayed less eagerness to infuse their own personal idiosyncrasies into the work, they would have done much more valuable service than they have actually accomplished.

The subject is too technical to enter into detailed criticism, and it must suffice merely to allude to three points in illustration of the difficulties which are placed in the way of the student.

One of the first fossils which every student must learn to know is the brachiopod *Terebratula*. Accordingly, Prof. von Zittel, in his "Grundzüge," gives a concise